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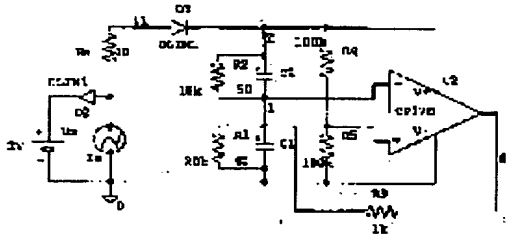
(54) CAPACITOR MODULE HAVING EQUALIZING FUNCTION



(57)Abstract:

PROBLEM TO BE SOLVED: To revise the difference in the voltage of a plurality of capacitors, connected in series and having low loss in an electronic circuit.

SOLUTION: This capacitor module, which has an equalizing function for equalizing a plurality of capacitors connected in series, and control circuits U2, R4, R5, and R9 are connected between two pieces of capacitors C1 and C2 connected in series, a current is compensated, according to the difference of the voltage between the two pieces of capacitors C1 and C2, so that the voltage is equal. The control circuit equalizes only the section of a leaked current, or controls the two capacitors so that their voltages equal, using a linear circuit, using an OP amplifier.

LEGAL STATUS

[Date of request for examination]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the capacitor module which has the identification function to equalize two or more capacitors connected to the serial.
[0002]
[Description of the Prior Art] With the accumulation-of-electricity equipment which made the capacitor the serial, the difference of the assignment electrical potential difference produced by the electrostatic capacity of each capacitor and the unevenness of the leakage current had become a problem. If service voltage is lowered to safe level in order to prevent destruction of the capacitor by this, accumulation-of-electricity capacity will be proportional to the square of an electrical potential difference from the property of valve flow coefficient2 / 2 known well, and accumulation-of-electricity capacity will decline sharply.
[0003] As a means to solve such a problem, the artificer has proposed a means to supervise and control the charge condition of the capacitor called some "juxtaposition monitors", and its special control approach (for example, Japanese Patent Application No. No. 324743 [ten to], Japanese Patent Application No. No. 9974 [11 to], the 1st ****** of the Michio Okamura work "electric double layer capacitor and accumulation-of-electricity system" Nikkan Kogyo Shimbun March 31, 1999 first edition, p145 - 159 reference).
[0004] However, since both tended to solve completely non-** of the capacitor electrical potential difference produced according to the variation in the electrostatic capacity of ** capacitor, and two causes that ** leakage current is unequal etc., the old approach had the problem which a circuit and control become complicated or temporary generation of heat produces in the case of rapid identification.
[0005] The fall of the electrostatic capacity by each variation of the electrostatic capacity of a capacitor or degradation in duration of service can be controlled now very few with the advance of the manufacturing technology of a capacitor in recent years. However, about the leakage current of capacitor each, it is difficult to control quality the quality of variation on various service conditions including a temperature change within very small limits which it said were 10% or less as usual.
[0006]
[Means for Solving the Problem] This invention solves the above-mentioned technical problem, and enables it to amend the difference of the electrical potential difference of two or more capacitors connected to low loss in the electronic circuitry at the serial.
[0007] Therefore, this invention is a capacitor module which has the identification function to equalize two or more capacitors connected to the serial. It is characterized by having the control circuit controlled so that a current is amended according to the difference of an electrical potential difference between two capacitors connected to the serial and an electrical potential difference becomes equal. Said control circuit It is

characterized by being the circuit which equalizes only the part of the leakage current and being the circuit controlled to become equal about the electrical potential difference of two capacitors in a linear circuit using an op amplifier.
[0008]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing. Drawing for drawing 1 to explain the gestalt of the operation of a capacitor module which has an identification function concerning this invention, and drawing 2 are drawings showing the result of having analyzed actuation by the circuit shown in drawing 1 by the simulation program (SPICE). the inside of drawing, and C1 and C2 -- in a capacitor and U2, a current source and Vs show a voltage source and, as for an op amplifier, and D1 and D2, R1, R2, R4, R5, R9, and Rs show resistance, as for diode and Is.
[0009] The capacitor module which has the identification function which relates to this invention to the capacitors C1 and C2 linked to a serial in drawing 1 It has the compensating network (control circuit) of the leakage current which consists of resistance R4, R5, and R9 and an op amplifier (operational amplifier) U2. A compensating network It operates with the power accumulated in capacitors C1 and C2, it operates so that the electrical potential difference a capacitor C1 and between C2 may be compared and a very small current may amend the difference, and only the part of the leakage current is equalized. That is, although the problem that generation of heat etc. is uncancelable will remain if a big current amends, a current is amended in the direction whose difference of an electrical potential difference is lost gradually. Connecting resistance R1 and R2 to juxtaposition, in order to differ the electrostatic capacity of capacitors C1 and C2 and to simulate leak resistance by drawing 1 R> 1 for the verification, the value gives 10kohm, 20kohm, and a twice as many difference as this, respectively. Resistance R4 and R5 is resistance of the same, sufficiently bigger value than the leak resistance R1 and R2 of a capacitor, and an op amplifier U2 makes a noninverting input the node (middle point of the applied voltage to two capacitors C1 and C2) of resistance R4 and R5, and it measures a reversal input for the electrical potential difference during these two inputs as a node of capacitors C1 and C2. The output of an op amplifier U2 compensates a current to the capacitor C1 with a lower electrical potential difference, or C2 through resistance R9 according to a comparison result, and resistance R9 is resistance for restricting so that the actuation may not become extremely not much quickly.
[0010] If the circuit which includes Hidari's current source Is, a voltage source Vs, diode D2, and Resistance Rs from diode D1 reaches about 3 V with a battery charger, it will serve as constant-potential charge. Even if the power source of an op amplifier U2 may be acquired from capacitors C1 and C2 and a battery charger may be removed, a compensating network is always connected to capacitors C1 and C2. since the withstand voltage of a capacitor is 2.5-3V in the electric double layer capacitor using the organic system electrolytic solution used now -- an op amplifier U2 -- a maximum of 5 -- the thing of about [-6V] supply voltage can be used.
[0011] Next, actuation is explained. An op amplifier U2 compensates the current which flows among capacitors C1 and C2 to the one where an electrical potential difference is lower by comparing the electrical potential difference of the middle point of the applied voltage to two capacitors C1 and C2 with the electrical potential difference of the node of capacitors C1 and C2. As opposed to the electrical potential difference of the middle point of the applied voltage to two capacitors C1 and C2 for example, when the electrical potential difference of the node of capacitors C1 and C2 is low It is the case that the electrical potential difference of a capacitor C1 is lower

than the electrical potential difference of a capacitor C2. The current which flows to a capacitor C1 with the output of an op amplifier U2 is compensated. When the electrical potential difference of the node of capacitors C1 and C2 is conversely high It is the case that the electrical potential difference of a capacitor C2 is lower than the electrical potential difference of a capacitor C1, and it operates so that the current which flows to a capacitor C2 with the output of an op amplifier U2 may be compensated.

[0012] It is desirable to operate as actuation of this circuit in the range which results in all discharge of a capacitor just like equalization resistance. Minimum operating voltage 1.7V are guaranteed and the 20micro consumed electric current [at the time of no outputting / about A] op amplifier is mass-produced by the advance of the component of the op amplifier by which current was integrated. If these are used, since it discharges on an electrical potential difference equal to 0.85V per one cel even when it is the worst, actuation of a circuit will become that an about [0.18V] difference remains, even if there is 20% of variations after it, for example. Since identification of this is again carried out next time at the time of use, it does not serve as big trouble. The problem from which the consumed electric current of an op amplifier itself turns into the leakage current is also smaller than the minimum leakage current of a capacitor a single figure in the capacitor of the general practical use level more than of number 100F.

[0013] If a capacitor C1 lessens residual-voltage 0.2V, a capacitor C2 lessens zero and electrostatic capacity of a capacitor C1 10% and it analyzes by the simulation program (SPICE), as shown in drawing 2 , the result Although it spread to per [to which C1 completes charge and charge completes the electrical-potential-difference difference of two capacitors early 10% / 6.5ks(es) (kilo second)] When the difference of the electrical potential differences V (1 0) and V (2 1) of two capacitors is shortened by effectiveness of an amendment current in connection with the passage of time after it and amendment is completed by 20ks, it turns out that it is falling to 74microA whose current which flows resistance R9 is the difference of the steady leakage current.

[0014] The electronic circuitry (op amplifier) which operates so that it may operate only with the power accumulated in the capacitor by which this invention was connected as mentioned above to the serial, the electrical potential difference between capacitors may be compared and a very small current may amend that difference is built in, by this electronic circuitry, active resistance is compounded and the leakage current of a capacitor is equalized automatically. It is the approach of solving without passing many currents like [in the case of using equalization resistance for reduction to which the residual voltage produced according to the solid-state difference of the leakage current which poses a problem becomes an ununiformity], when a capacitor is made into a serial. In order to carry out automatic amendment according to the very small current which supplies the leakage current of a capacitor from the electronic circuitry where it always connected, there is neither temporary generation of heat looked at by the juxtaposition monitor nor an exchange with an external control circuit, and it is brief, and since cheapness and a serial capacitor uniform moreover can be considered, it becomes easy to use.

[0015] Drawing showing the example which applied the example which shows drawing 3 to drawing 1 to the series circuit of three capacitors, and drawing 4 are drawings showing the electrical potential difference of each part in the circuit shown in drawing 3 , and transition of a current. The inside of three capacitors C1, C2, and C3 which according to above-mentioned this invention were connected to the serial as

shown in drawing 3 , As opposed to the circuit which compares the leakage current of two capacitors C1 and C2 which consist of resistance R4, R5, and R9 and op amplifiers U2 By being able to shift the circuit which compares the leakage current of two capacitors C2 and C3 which consist of resistance R14, R15, and R19 and op amplifiers U3 every one capacitor, and piling it up, it can apply similarly and can apply like the system which connected many capacitors with four more pieces and .... at the serial.

[0016] In order to apply the method of this invention there, an excessive op amplifier circuit is established in the one topmost part of each module, and it is made not to operate practically, although the module to which the capacitor single cel was summarized makes ten cels a serial and puts them into one container. And what is necessary is just to connect with a node 1 in the circuit shown in the terminal of the upper limit of the capacitor of the modular bottom which comes upwards taking advantage of the op amplifier, and drawing 3 , in case a module is made into a serial. What made this separately when it could constitute even if carried out, but manufacturing a module and defining [the upper and lower sides, on the contrary] the standard firmly can make a module a serial at arbitration, and can equate mutual electrical-potential-difference allocation.

[0017] Drawing 4 showed the electrical potential difference of each part at the time of operating the circuit shown in drawing 3 , and transition of a current, and it is the result of carrying out transient analysis by the simulation program (SPICE). Here, there are two amendment currents, lessons is fallen and taken for the first amendment current which flows resistance R9 from a stationary value per 1.5ks(es), and the current which flows the another side resistance R19 flowing to per 29ks(es), and starting amendment of the leakage current steady after that is accepted.

[0018] In addition, this invention is not limited to the gestalt of the above-mentioned implementation, and various deformation is possible for it. For example, a switching method may be adopted although controlled by the gestalt of the above-mentioned implementation to become equal about the electrical potential difference of two capacitors in a linear circuit using an op amplifier. Moreover, although it is an electrical-potential-difference equalization method theoretically, it is because the cause of stopping at the "leakage current" limits amendment to the output current of an op amplifier, and you may enable it to compensate the difference of not only the leakage current but electrostatic capacity for the object to equalize by making it high power and enabling it to amend an electrical-potential-difference difference, although the effectiveness cannot equate the electrical-potential-difference allocation by the variation in electrostatic capacity when compensating the leakage current.

[0019]

[Effect of the Invention] According to this invention, as a capacitor module which has the identification function to equalize two or more capacitors connected to the serial so that clearly from the above explanation Since it has the control circuit controlled so that a current is amended according to the difference of an electrical potential difference between two capacitors connected to the serial and an electrical potential difference becomes equal The electronic circuitry which operates so that it may operate only with the power which the capacitor connected to the serial stored electricity as a control circuit, the electrical potential difference between capacitors may be compared and a minute current may amend the difference can be built in, and the leakage current of a capacitor can be equalized automatically. In current [by which an op amplifier is obtained very cheaply], the effectiveness which electrical-potential-difference identification of a capacitor can be realized easily cheaply, and

the problem of electrical-potential-difference allocation of a capacitor is solved, and can be treated like one high-voltage capacitor is size.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the capacitor module which has the identification function to equalize two or more capacitors connected to the serial.

[Translation done.]

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TECHNICAL PROBLEM

[Description of the Prior Art] With the accumulation-of-electricity equipment which made the capacitor the serial, the difference of the assignment electrical potential difference produced by the electrostatic capacity of each capacitor and the unevenness of the leakage current had become a problem. If service voltage is lowered to safe level in order to prevent destruction of the capacitor by this, accumulation-of-electricity capacity will be proportional to the square of an electrical potential difference from the property of valve flow coefficient2 / 2 known well, and accumulation-of-electricity capacity will decline sharply.
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MEANS

[Means for Solving the Problem] This invention solves the above-mentioned technical problem, and enables it to amend the difference of the electrical potential difference of two or more capacitors connected to low loss in the electronic circuitry at the serial.
[0007] Therefore, this invention is a capacitor module which has the identification function to equalize two or more capacitors connected to the serial. It is characterized by having the control circuit controlled so that a current is amended according to the difference of an electrical potential difference between two capacitors connected to the serial and an electrical potential difference becomes equal. Said control circuit It is characterized by being the circuit which equalizes only the part of the leakage current and being the circuit controlled to become equal about the electrical potential difference of two capacitors in a linear circuit using an op amplifier.
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[0010] If the circuit which includes Hidari's current source Is, a voltage source Vs, diode D2, and Resistance Rs from diode D1 reaches about 3 V with a battery charger, it will serve as constant-potential charge. Even if the power source of an op amplifier U2 may be acquired from capacitors C1 and C2 and a battery charger may be removed, a compensating network is always connected to capacitors C1 and C2. since the withstand voltage of a capacitor is 2.5-3V in the electric double layer capacitor using the organic system electrolytic solution used now -- an op amplifier U2 -- a maximum of 5 -- the thing of about [-6V] supply voltage can be used.
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[0015] Drawing showing the example which applied the example which shows drawing 3 to drawing 1 to the series circuit of three capacitors, and drawing 4 are drawings showing the electrical potential difference of each part in the circuit shown in drawing 3 , and transition of a current. The inside of three capacitors C1, C2, and C3 which according to above-mentioned this invention were connected to the serial as shown in drawing 3 , As opposed to the circuit which compares the leakage current of two capacitors C1 and C2 which consist of resistance R4, R5, and R9 and op amplifiers U2 By being able to shift the circuit which compares the leakage current of two capacitors C2 and C3 which consist of resistance R14, R15, and R19 and op amplifiers U3 every one capacitor, and piling it up, it can apply similarly and can apply like the system which connected many capacitors with four more pieces and .... at the serial.

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[0017] Drawing 4 showed the electrical potential difference of each part at the time of operating the circuit shown in drawing 3 , and transition of a current, and it is the result of carrying out transient analysis by the simulation program (SPICE). Here, there are two amendment currents, lessons is fallen and taken for the first amendment current which flows resistance R9 from a stationary value per 1.5ks(es), and the current which flows the another side resistance R19 flowing to per 29ks(es), and starting amendment of the leakage current steady after that is accepted.

[0018] In addition, this invention is not limited to the gestalt of the above-mentioned implementation, and various deformation is possible for it. For example, a switching method may be adopted although controlled by the gestalt of the above-mentioned implementation to become equal about the electrical potential difference of two capacitors in a linear circuit using an op amplifier. Moreover, although it is an electrical-potential-difference equalization method theoretically, it is because the cause of stopping at the "leakage current" limits amendment to the output current of an op amplifier, and you may enable it to compensate the difference of not only the leakage current but electrostatic capacity for the object to equalize by making it high

power and enabling it to amend an electrical-potential-difference difference, although the effectiveness cannot equate the electrical-potential-difference allocation by the variation in electrostatic capacity when compensating the leakage current.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing for explaining the gestalt of the operation of a capacitor module which has an identification function concerning this invention.
[Drawing 2] It is drawing showing the result of having analyzed actuation by the circuit shown in drawing 1 by the simulation program (SPICE).
[Drawing 3] It is drawing showing the example which applied the example shown in drawing 1 to the series circuit of three capacitors.
[Drawing 4] It is drawing showing the electrical potential difference of each part in the circuit shown in drawing 3 , and transition of a current.
[Description of Notations]
C1, C2 [-- A current source Vs / -- A voltage source R1, R2, R4, R5, R9, Rs / -- Resistance] -- A capacitor, U2 -- An op amplifier, D1, D2 -- Diode, Is

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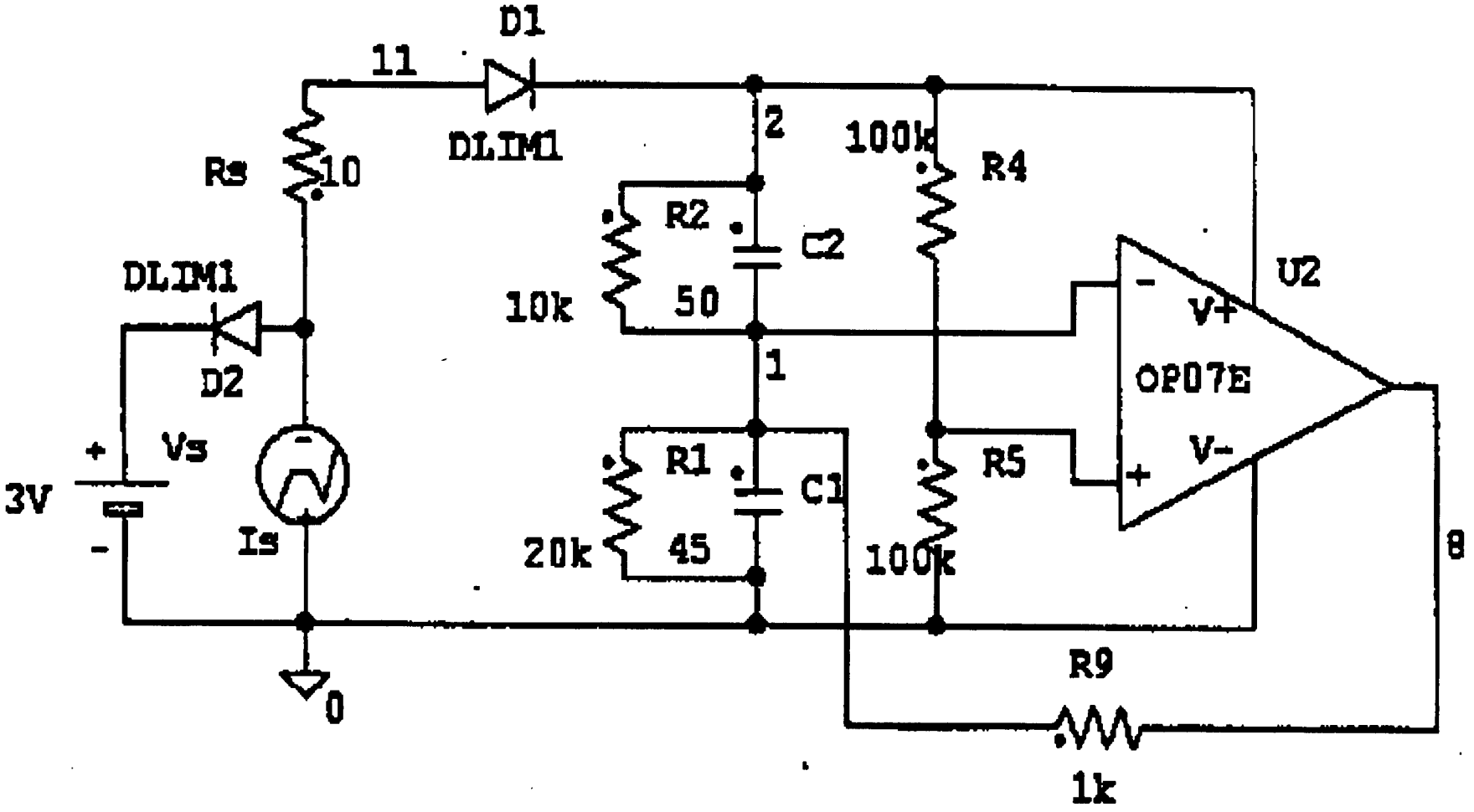
[Translation done.]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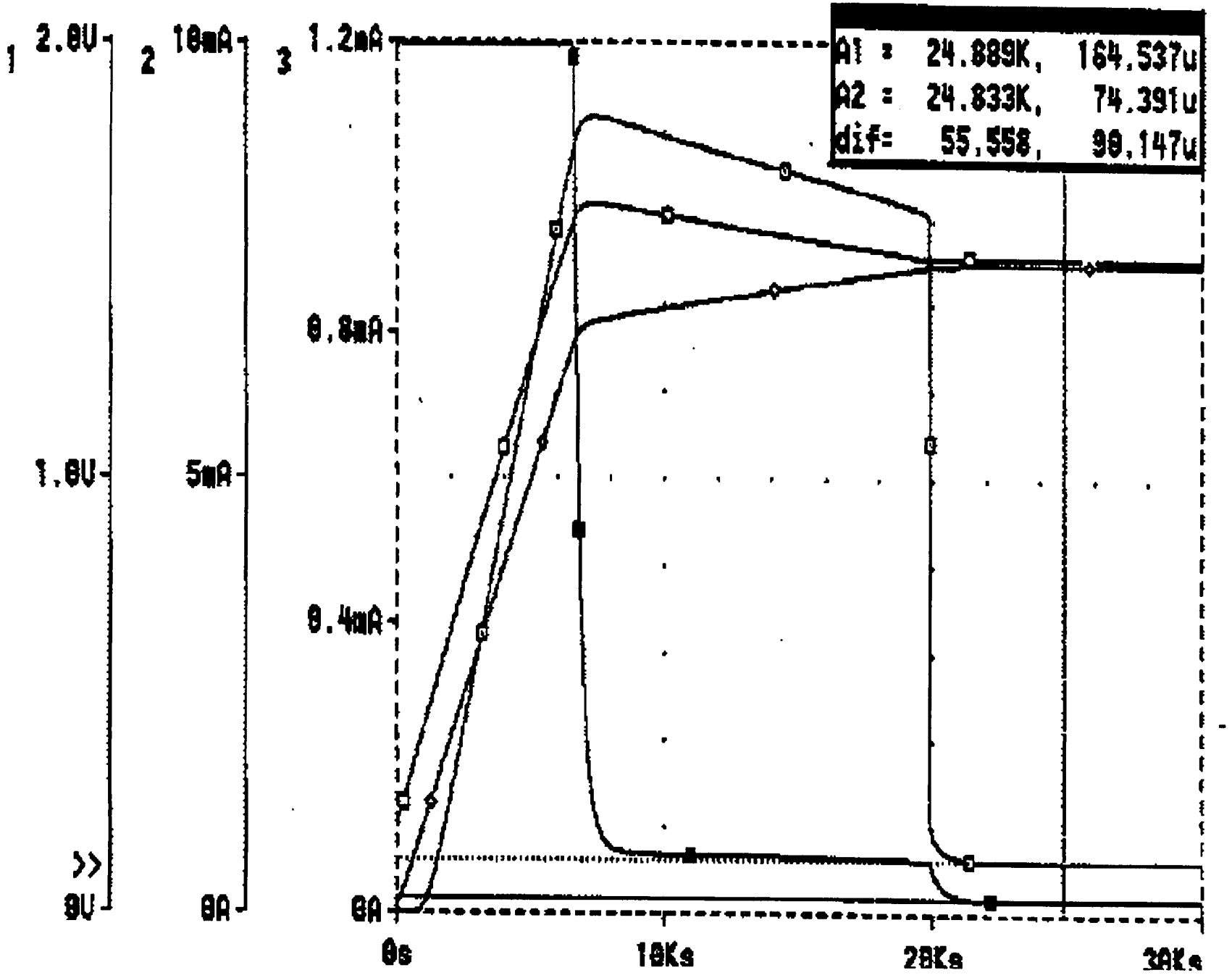
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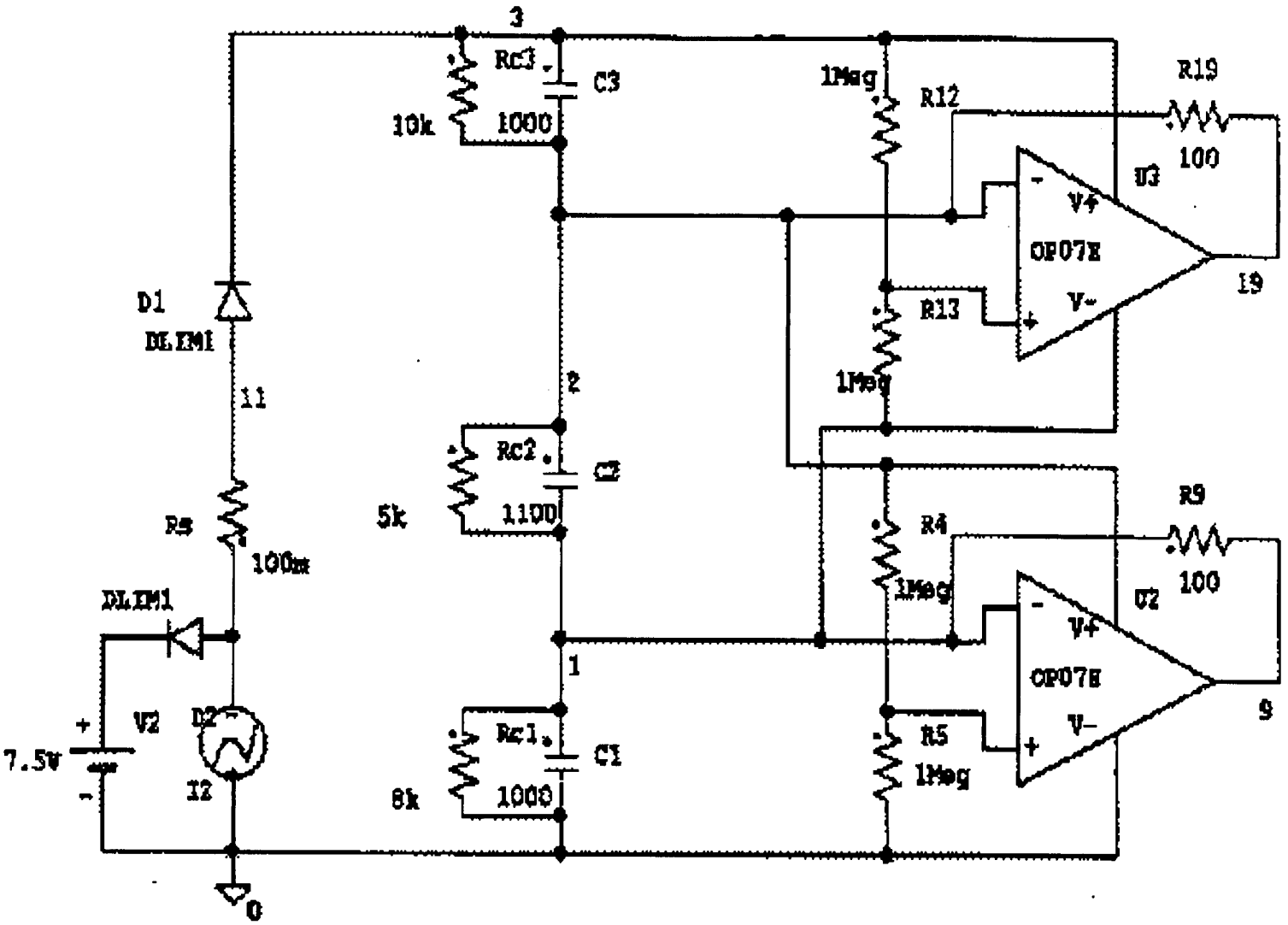
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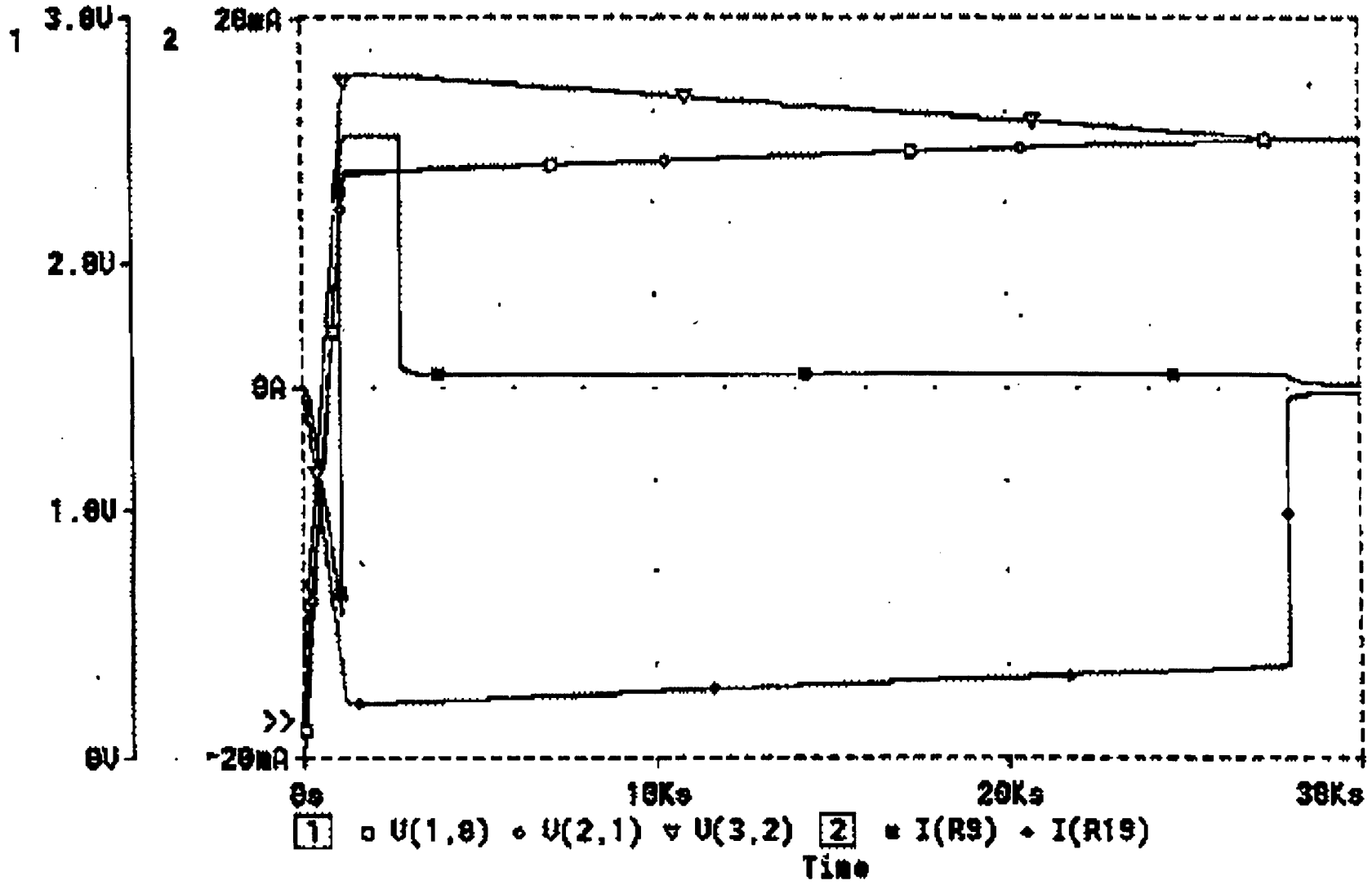
1Meg
0


1
3.0V
2.0V
1.0V
0V
2
20mA
0A
-20mA
>>
0s
10Ks
20Ks
30Ks
1 V(1,0) V(2,1) V(3,2) 2 I(R9) I(R19)
Time